Alaska Snow Experiment for Applications of Scatterometry to Snow Remote Sensing

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Snow cover influences the global heat budget through its albedo and insulating properties. It plays an important role in many climate feedback processes. Its year-to-year variability is a significant climatic index that is linked to changes in climate. Moreover, snow cover parameters are necessary for forecast models to predict water supply and severe weather events such as flooding.

We carried out a snow field experiment in Alaska from March to April 1999 to investigate applications of satellite Ku-band scatterometer for snow remote sensing. Ku-band radar waves are appropriate for snow cover monitoring because they respond strongly to changes in snow properties, they can penetrate most seasonal snow packs, and they are mostly unaffected by atmospheric effects. Furthermore, the scatterometer can be designed for a good resolution (1 km to 25 km) and for a wide swath (2000 km).

The objective of the field experiment was to measure snow and ground backscatter before, during, and after the snow melt as the electromagnetic signature underwent large changes. We obtained Ku-band backscatter signatures from a tower-based Ku-band scatterometer, together with detailed snow physical characteristics including snow depth, density, snow water equivalent, grain size distribution, temperature, wetness, and layering. We made simultaneous suites of measurements of the snow cover albedo in order to link the Ku-band measurements directly to a climatologically important parameter. Measurements were obtained from three distinct phases of the melt: 100% snow cover with diurnal freeze-thaw effects, discontinuous snow cover with extreme freeze-thaw effects, and ground thaw with residual snow (thaw depth from 0 cm to 10 cm). In all cases, backscatter was measured over a large range of incidence angles with multiple polarizations. Several special cases were also investigated by artificially altering the snow and ground cover. The snow field experimental results are applied to the interpretation of backscatter data acquired by spaceborne Ku-band scatterometers such as NSCAT and QuikSCAT.